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II: (applicable for all values of m)

We can tabulate all possible common factors of either set of three brackets, namely; the following, and no others, will be common factors: in several cases, 2 is a common factor; any factor common to $(m + n)$ and $(p + q)$; any factor common to $(m - n)$ and $(p - q)$; in I, any factor common to n and p; in II, any factor common to n and q.

An excellent solution of the special problem was received from S. A. JOFFE.

210. Proposed by ELMER SCHUYLER, Brooklyn, N. Y.

If a and b are relatively prime and $(a + b)$ is even, then

$$(a - b)ab(a + b) \equiv 0 \pmod{24}.$$

SOLUTION BY L. C. MATHEWSON, Urbana, Ill.

Since a and b are relatively prime, at most only one can be even; furthermore, since their sum is even, they must both be odd. Accordingly, let

$$a = 2a_1 + 1, \qquad b = 2b_1 + 1.$$

Then

$$\begin{aligned}(a - b)(a + b) &= 4a_1^2 - 4b_1^2 + 4a_1 - 4b_1\\ &= 4(a_1 + b_1 + 1)(a_1 - b_1).\end{aligned}$$

If, now, a_1 and b_1 are both even or both odd, $a_1 - b_1$ is divisible by 2 and thus $(a - b)(a + b)$ divisible by 8. If either a_1 or b_1 is odd (the other even), then $a_1 + b_1 + 1$ is divisible by 2 and thus $(a - b)(a + b)$ divisible by 8. Hence, in either case, under the conditions of the problem

$$(a - b)ab(a + b) \text{ is divisible by } 8.$$

Should at least one of the two given numbers be divisible by 3, then the solution would be evident. If neither a nor b is divisible by 3, then

$$a \equiv 1 \text{ or } 2, \text{ mod } 3, \qquad \text{and} \qquad b \equiv 1 \text{ or } 2, \text{ mod } 3.$$

If both a and b are congruent to 1 or to 2 (mod 3), then $(a - b)$ is divisible by 3; if one is congruent to 1 and the other to 2, then $(a + b)$ is divisible by 3. Hence, in all cases under the conditions of the problem

$$(a - b)ab(a + b) \text{ is divisible by } 3.$$

Therefore, since $(a - b)ab(a + b)$ is divisible by 8 and also by 3,

$$(a - b)ab(a + b) \equiv 0, \pmod{24}.$$

Also solved by S. W. REAVES, H. T. BIGELOW, S. A. JOFFE, ELIJAH SWIFT, HORACE OLSON, E. E. WHITFORD, and H. C. FEEMSTER.